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A REVIEW OF INTEGRATED RENEWABLE ENERGY SYSTEM IN POWER GENERATION

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ABSTRACT

Today's crisis in the field of energy supplies, environmental control, and population increase, poverty and shortage of food and materials are closely interrelated. Integrated Renewable energy system discussed in this paper aim at mix of possible renewable energy sources taking in to consideration sector-wise energy demand along with socio-economic and environmental aspects of energy use. Use of energy, whether renewable or non-renewable and its effect leads to different kinds of arguments in terms of its effect on environment, social cost and economic viability.

Solar energy when considered on human scale is renewable and is environmentally acceptable, but its use is still in primitive stage in many parts of the country mainly because of economic barriers. Likewise, biomass energy is being used in many forms all over the world, but the most needed eco-friendly forms are still in premature stage in most of theworld. The present paper highlights the perspectives and some issues related to integrated renewable energy system.

KEYWORDS: Integrated Renewable Energy, Wind Energy, Solar Energy, Power Generation

INTRODUCTION

Energy is a basic ingredient needed to sustain life and development. Energy is needed in various forms to fulfill our day to day requirements. Ever-increasing gap between demand and supply of energy, growing concerns about the environmental degradation associated with the use of fossil fuels and escalation cost of energy have forced the scientific community to find and develop alternate sources of energy. [1].

Renewal Energy describes energy obtained from sources, such as the sun, wind, water, and organic plant matter and geothermal, the heat found inside the Earth. Renewable sources of energy are readily available. Renewable energy is a form of energy that can be produced without depleting natural resources such has fossil fuels and wood. It does not rely on the burning of a fossil fuel to create electricity. Some forms of renewable energy include sunlight, wind, tides, water and geothermal heat. The use of biomass is also considered to be a renewable energy source. This type of energy is sustainable as it is derived from sources that do not run out. Renewable energy facilities generally require less maintenance than traditional generators. Their fuel being derived from natural and available resources reduces the costs of operation [2].

DIFFERENT INTEGRATED RENEWABLE ENERGY SYSTEMS PREVIOUS RESEARCH

All countries have access to some renewable energy resources and in many parts of the world these are abundant. The characteristics of many of these resources distinguish them from fossil fuels and nuclear systems and have an impact on their integration. Some resources, such as solar, are widely distributed, whereas others, such as large hydro, are constrained by geo-graphic location and hence integration options are more centralized. Some renewable energy resources are variable and have limited predictability.

Others have lower energy densities and different technical specifications from solid liquid and gaseous fossil fuels. Such renewable energy resource characteristics can constrain their ease of integration and invoke additional system costs, particularly when reaching higher shares of renewable energy. It outlines how renewable energy resources can be used through integration into energy supply networks that deliver energy to consumers using energy carriers with varying shares of renewable energy embedded and directly by the transport, buildings, industry and agriculture end-use sectors as shown in Figure 1[3].

To achieve such increased shares of renewable energy in total energy supply by 2035 and beyond will require overcoming the challenges of integration in each of the transport, building, industry and agriculture sectors. In order to gain greater RE deployment, strategic elements need to be better understood as do the social issues. Transition pathways for increasing the shares of each renewable energy technology through integration should aim to facilitate a smoother integration with energy supply systems but depend on the specific sector, technology and region as shown in Figure 2 [3].

Nikolova et al. [4] presents an approach for solving the generation scheduling problem of a complex system consisted of conventional and renewable energy sources (RES). Wind power plants are integrated into the system in order to minimize the total thermal unit fuel costs. The gained results for wind farm power production are used as input in the system to determine the optimal amounts of generated power for the thermal generating units and hydro generating units over the study period.

Pappala VS [5] Wind power is widely researched and various methods have been developed for optimal operation and generation scheduling of wind integrated power systems. The authors presented a stochastic cost model and a solution technique to address the influence of demand and wind generation uncertainties on the optimal operation of the power system with wind generation. Li and Kuri [6] investigated the impact of increasing the penetration of intermittent wind generation on the generation schedule, particularly on the overall fuel cost, system security and amount of emissions.

Castronuovo and Peças Lopes [7] presented an optimization approach which can help for identifying the best strategy for the operation of a combined wind–hydro pumping storage power plant. From the solution of the optimization problem it is possible to determine the hourly operation of the water pump station, mini hydro generator and wind generator, Integration ofenergy storage devices and pumped storage hydro power plants in a sys-tem with wind power plants is an alternative for compensating the intermittent nature of wind power generation. Various methods have been developed for operation and generation scheduling of such wind-storage combined systems [8–10].

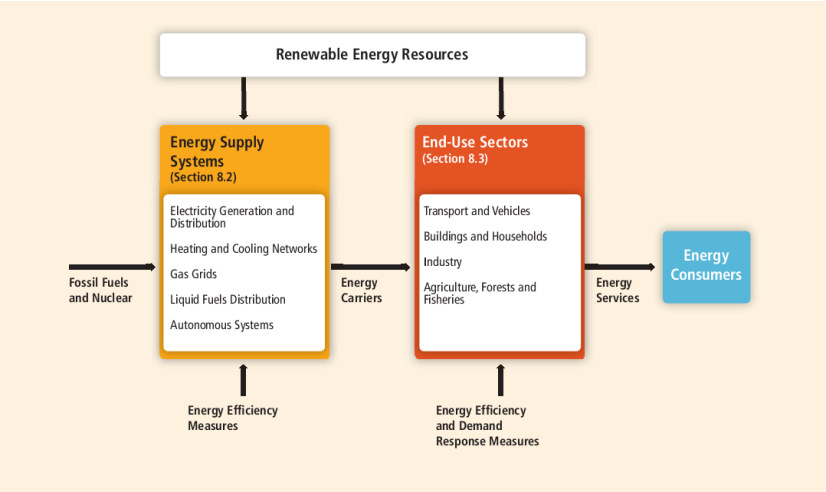

Figure 1: Pathways for Renewable Energy Integration to Provide Energy Services. Either into Energy Supply Systems or Site for Use End-Use Sectors [3]

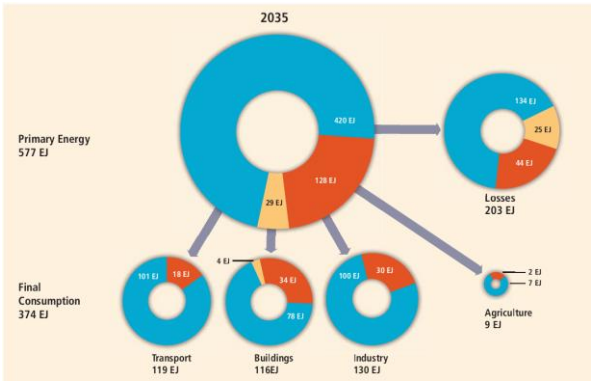

Figure 2: Renewable Energy Shares (Red) of Primary and Final Consumption Energy in the Transport, Buildings (Including Traditional Biomass), Industry and Agriculture Sectors in 2035 [3]

Barton and Infield [8] presented a simple probabilistic method to predict the ability of energy storage to increase the penetration of intermittent embedded renewable generation on weak electricity grids and to enhance the value of the electricity generated by time-shifting delivery to the network. The authors investigated the value of storage in relation to power rating and energy capacity.The presented method can estimate the fraction of time the store is empty or full, the amount of wind energy that must curtailed and the amount of electrical demand left unsatisfied by wind power alone [9]. Castronuovo and Peças Lopes in [10] proposed an optimization approach to identify the best-combined daily operation strategy to be adopted in a wind and small hydro generation/pumping facility

MACRO-LEVEL INTEGRATED RENEWABLE ENERGY PRODUCTION

Deshmukh, M.K., Deshmukh **[11]**Hybrid energy system is an excellent solution for electrification of remote ruralareas where the grid extension is difficult and not economical. Recently, Chinese government has taken the concept of industrial ecology and EIPs as a key industrial policy in their agenda 21, Fang et al., 2007[12] and accepted by Chinese government for new wave of industrial development.

Renew-able energy technologies are often recognized as less competitive than traditional electric energy conversion systems. Obstacles with renewable electric energy conversion systems are often referred to the intermittency of the energy sources and the relatively high initial capital cost (Skoglund et al., 2010) [13]

SIZING OF INTEGRATED RENEWABLE ENERGY SYSTEM BASED ON LOAD PROFILES AND RELIABILITY INDEX FOR THE STATE OF UTTARAKHAND IN INDIA

Kanasepatil et al. [14] deals with the electrification of dense forest areas of Uttarakhand state in India by Integrated Renewable Energy Optimization Model (IREOM). The IREOM consists of locally available renewable energy resources such as Micro-Hydropower (MHP), biomass, biogas, wind and solar photovoltaic (SPV) systems have been used to meet electrical energy and cooking energy needs of a cluster of villages.

An integrated wind/hydro approach has been used for operational optimization of system components and reduction of electricity cost fora remote island [15-22].

INTEGRATED RENEWABLE ENERGY SYSTEMS FOR OFF GRID RURAL ELECTRIFICATION OF REMOTE AREA

Kanasepatil et al. [23]The off grid electrification by utilizing Integrated Renewable Energy System (IRES) is proposed to satisfy the electrical and cooking needs of the seven unelectrified villages in the Almora district of

Uttarakhand state, India. Four different scenarios are considered during modeling and optimization of IRES to ensure reliability parameters such as energy index ratio (EIR) and expected energy not supplied (EENS). The optimum system reliability, total system cost and cost

The unit COEas calculated using the standard procedures **[24, 25]** is given in**Table.1.**

Table 1: Cost of Energy (COE)

Sr. No.	Parameters	Resources				
		MHP	SPV	BES	Biogas	WES
1	Energy Generation (kWh/yr)	233 040	1837	198 556	34 256	8890
2	System Rating (kW)	63	1	40	10	3
3	System Operating Hours (hrs/yr)	4535	1837	5100	3500	2975
4	Amortization Period (Year)	25	30	15	20	20
5	Capital Cost (Rs/kW)	70000	225000	30000	20000	80000
6	O & M Cost (%)	2	2	2	2	2
7	Annual Interest Rate (%)	10	10	10	10	10
8	Fuel Cost (Rs/kWh)	-	-	3	2.99	-
9	Cost of Energy (Rs/kWh)	1.96	15.44	4.38	4.32	3.48

The total system cost is the summation of system cost and calculated CIC. The part of the system cost with the reliability for all systems considered for different scenarios is shown in Figure 3.

The concept of Integrated Renewable Energy Systems (IRES) was first proposed by Ramakumar[26–30]who evaluated the techno-economic aspects of a small-scale decentralized IRES for existing renewable energy sources in the rural areas of developing countries.

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EVALUATION OF AN INTEGRATED RENEWABLE ENERGY SYSTEM FOR ELECTRICITY GENERATION IN RURAL AREAS

SteliosRozakis and Peter G Soldatos [37] studied that Renewable energy deployment has been growing during the past twenty-five years, transforming renewables potential to actual energy production and increasing their share in the energy supply landscape. Moreover, because of their decentralized nature, renewable energy applications have a considerable potential in rural areas [38-39].

OPTIMUM UTILIZATION OF RENEWABLE ENERGY SOURCES IN A REMOTE AREA (UTTRAKHAND STATE)

A.K. Akella et.al.[40] studied that Energy is supplied in the form of electricity, heat or fuels and an energy supply system must guarantee sustainable energy supplies, production and distribution of energy. Such system based on renewable energy can be utilized as integrated renewable energy system (IRES), which can satisfy the energy needs of an area in appropriate and sustainable manner. For renewable energy based rural electrification of remote areas, the IRES can be modeled and optimized for meeting the energy needs. For the purpose, the Jaunpur block of Uttaranchal state of India has been selected as remote area.

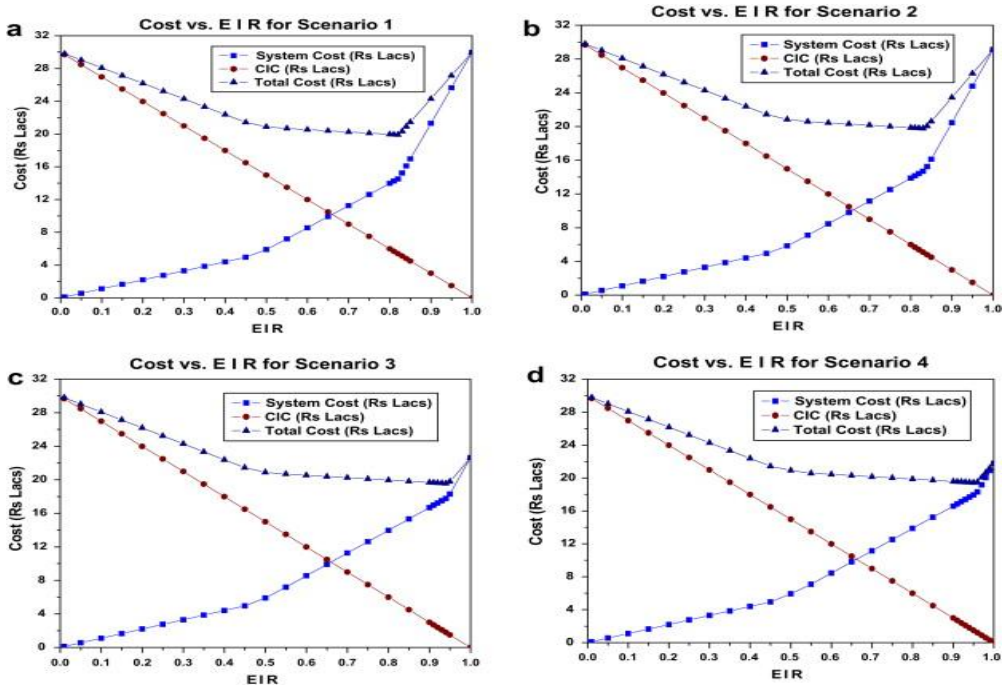

Figure 3: Variation of Cost of System with EIR

SIZING AND COST ANALYSIS FOR INTEGRATED RENEWABLE ENERGY SYSTEM IN A STUDY AREA

A. K. Akellaet.al[41]. present in this paper that the renewable energy sources such as micro hydro, biomass, wind, solar photovoltaics can provide clean and sustainable electricity; as a result, many of sources are already proving cost-competitive contributing about 2% of the total electricity supply of the country. However, one of the issues limiting their greater penetration is done to its intermittent and seasonal availability for energy production.

INTEGRATED RENEWABLE ENERGY SYSTEM - PERSPECTIVES AND ISSUES

Pramod S. Dabraseet.al [42].Today's crisis in the field of energy supplies, environmental control, population increase, poverty and shortage of food and materials are closely interrelated. It is gradually realized that they demand a holistic, systematic and integrated approach to deal with.

Now we see that a 5 % yearly increase in the use of energy not only points to fuel depletion, but is also a main cause for increase in pollution level and related disasters. Integrated Renewable energy system aim at mix of possible renewable energy sources taking in to consideration sector-wise energy demand along with socio-economic and environmental aspects of energy use. Use of energy, whether renewable or non-renewable and its effect leads to different kinds of arguments in terms of its effect on environment, social cost and economic viability.

ROLE OF COMPUTER TOOLS FOR ANALYZING THE INTEGRATION OF RENEWABLE ENERGY INTO VARIOUS ENERGY SYSTEMS

In recent times more diverse challenges have emerged in society such as climate change, security of energy supply, and economic recession. As a result, the energy sector, especially renewable energy, is being targeted to combat these issues. To be more precise, converting from an energy-system that is dependent on imported fossil-fuels to a renewable energy-system can play a significant role in solving these issues [43-48].

RENEWABLE ENERGY TECHNOLOGIES INTEGRATED WITH DESALINATION SYSTEMS

Water has been recognized as a basic human right. Large quantities of fresh water are required in many parts of the world for agricultural, industrial and domestic uses. As of today, nearly one fourth of mankind is suffering from inadequate fresh water supply [49].

Water consumption increased sevenfold since 1900. In total, water demand doubles every 20-year. Fresh water resources are almost completely exhausted in many middle-east countries [50].

Most of the water available on earth has the salinity up to 10,000 ppm whereas seawater normally has salinity in the range of 35,000–45,000 ppmin the formof total dissolved salts [51].

CONCLUSIONS

- Renewable energies for use in desalination processes include wind, solar thermal, photovoltaic and geothermal. Renewable energy driven desalination systems fall into two categories. The first category includes distillation processes driven by heatproduced by the renewable energy systems, while the second includes membrane and distillation processes driven by electricity or mechanical energy produced by RES.
- The most investigated mode of coupling between RES and desalination processes is the use of direct sun rays to produce fresh water by means of solar stills. Numerous attempts to harness solar thermal energy for water distillation have been carried out in many places worldwide
- Energy is supplied in the form of electricity, heat or fuels and an energy supply system must guarantee sustainable energy supplies, production and distribution of energy. Such system based on renewable energy can be utilized as integrated renewable energy system (IRES), which can satisfy the energy needs of an area in appropriate and sustainable manner.
- The interface between the renewable energy system and the desalination system is met at the place/subsystem where the energy generated by the RE system is promoted to the desalination plant. This energy can be in different forms such as thermal energy, electricity or shaft power.
- Processes driven by solar energy generally fall into two categories, those that capture and utilize the thermal energy of the sun, and those that use photovoltaic (PV) devices to generate electricity. Solar stilts are used to produce the hydrological cycle on a much smaller scale by directly utilizing sunshine. Construction and operation principle of solar stills are simple.
- Renewable energy technologies are often recognized as less competitive than traditional electric energy conversion systems. Obstacles with renewable electric energy conversion systems are often referred to the intermittency of the energy sources and the relatively high initial capital cost.
- Integrated Renewable energy system aim at mix of possible renewable energy sources taking into consideration sector-wise energy demand along with socio-economic and environmental aspects of energy use. Use of energy, whether renewable or non-renewable and its effect leads to different kinds of arguments in terms of its effect on environment, social cost and economic viability.

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